NOTE

Effect of Addition of Alcohols on Gelation of Polyvinyl Alcohol Aqueous Solution by γ -Ray Irradiation

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1. Introduction

Previously the author reported the effect of inorganic acids or bases on gelation of aqueous solution of polyvinyl alcohol (PVA)¹⁾. Below the critical concentration, the effect was investigated by color development with iodine after γ -ray irradiation. In the present study the effect of several alcohols on the gelation was investigated. Methanol, ethanol, isopropyl alcohol, cyclohexanol and phenol were used as additives.

2. Experimental

The procedures of the preparation of sample solutions and irradiation were the same as described previously¹⁾. The viscometric degree of polymerization of PVA was 1790.

3. Results and discussion

The ratios of the absorbances of the PVA-iodine complex of the irradiated samples to those of unirradiated were plotted against the absorbed dose and were referred to as the relative absorbance in Figs. 1-3. Figure 1 shows the effect of the concentration of methanol on the absorbance. The absorbances decrease with a decrease in concentration. Similar results were obtained with ethanol and isopropyl alcohol. H and OH radicals produced by radiolysis of

water predominantly abstract α -hydrogen of aliphatic alcohols.

where R is H and/or CH₃. Reaction 2 is known to play a major role in the dehydrogenation²⁾. Therefore the protection of PVA is considered to be done mainly by the reaction of OH radicals with these alcohols.

Fig. 1 Effect of the concentration of methanol on the relative absorbance. The concentration of polyvinyl alcohol is 0.1% (w/v).

Figure 2 shows the effect of concentration of phenol on the absorbance. In this instance the absorbances are little affected by concentration. Similar results were obtained with cyclohexanol. Hydroxyl radicals have high electro-

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philic nature on and high reactivity toward aromatic compounds³⁾.

Fig. 2 Effect of the concentration of phenol on the relative absorbance. The concentration of polyvinyl alcohol is 0.1% (w/v).

Figure 3 shows the effect of the addition of different alcohols on the absorbance. The typical rate constants of OH radicals with methanol, ethanol, isopropyl alcohol and phenol are 8.8×10^8 , 1.8×10^9 , 2.0×10^9 and $1.8 \times 10^{10} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$, respectively⁴⁾. The extent of protection by the addition of these alcohols increases in the above order. While the rate constant with cyclohexanol is not found in the literature, cyclohexanol produces mainly α -hydroxycyclohexyl radical⁵⁾. In addition, the γ - and δ -radicals are formed in a small fraction. It seems reasonable that the extent of protection by such a alicyclic compound is situated between those by aliphatic and aromatic compounds.

Fig. 3 Effect of different alcohols on the relative absorbance. The concentrations of polyvinyl alcohol and the alcohols are 0.1% (w/v) and 10^{-3} M , respectively.

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References

- 1) H. Narasaki: *Radioisotopes*, 27, 568(1978)
- 2) M. Simic, P. Neta and E. Hayon: *J. Phys. Chem.*, 73, 3794 (1969)
- 3) M. Anbar, D. Meyerstein and P. Neta: *ibid.*, 70, 2660 (1966)
- 4) G.E. Adams, J.W. Boag, J. Currant and B.D. Michael: "Pulse Radiolysis", p. 131, Academic Press, New York (1965)
- 5) T. Shiga, A. Boukhors and P. Douzou: *J. Phys. Chem.*, 71, 4264 (1967)